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Philips Medical Systems

Replacement Kit PCB KV-Control-4

4512 105 00061

Level 0 Documentation

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SERVICE MANUAL –UNIT

Replacement Kit PCB KV-Control-4

Author: Th. Frenschek

File: Replacement kit PCB KV4_00321AA

List of pages and drawings (LOPAD)

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1. INTRODUCTION AND TECHNICAL DATA

1.1. PURPOSE OF MANUAL

When the service engineer orders an old PCB KV-Control-4 (4512 108 0910x), service logistics automatically sends a new PCB KV-Control-4 with the associated software PROM D800 4512 113 xxxxx according to the generator type OPTIMUS RAD, R/F and C generators since the new PCB KV-Control-4 (4512 178 00281) is no longer compatible with the old KV-Control software.

1.2. ITEMS SUPPLIED

4512 105 00061 Kit: "Replacement of PCB KV-Control-4"

Consists of:

-	4512 178 00281	Unit KV-Control-4	(EZ 130)
-	4512 113 20141	KV Control RAD software	(EZ 130 D800)
-	4512 113 26221	KV Control R/F software	(EZ 130 D800)
-	4512 988 00321	This manual	

1.3. COMPATIBILITY

The kit "4512 105 00061 is compatible with PCB EZ130 "4512 108 0910x".

1.4. TOOLS/MATERIAL REQUIRED

- Standard tool set TC 129

1.5. SAFETY INFORMATION

The general legal and factory safety recommendations for this X-ray equipment and the following recommendations must be strictly observed!
Start of installation, operation and maintenance work and especially electrical work must only be executed by trained and authorized persons. This equipment must only be serviced by properly educated service specialists who have received general and system-specific training as performed by Philips Medical Systems.

WARNING

The system/component must be switched OFF during replacement work.
Any X-ray unit produces ionizing radiation which may be harmful if not properly controlled. Therefore, it is recommended that this equipment be operated in accordance with the guidelines set down by the national council on radiation protection.

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2. INSTALLATION

2.1. GENERAL

WARNING

When handling PCBs take all necessary electro static discharge (ESD) precautions!

2.2. PREPARATORY WORK

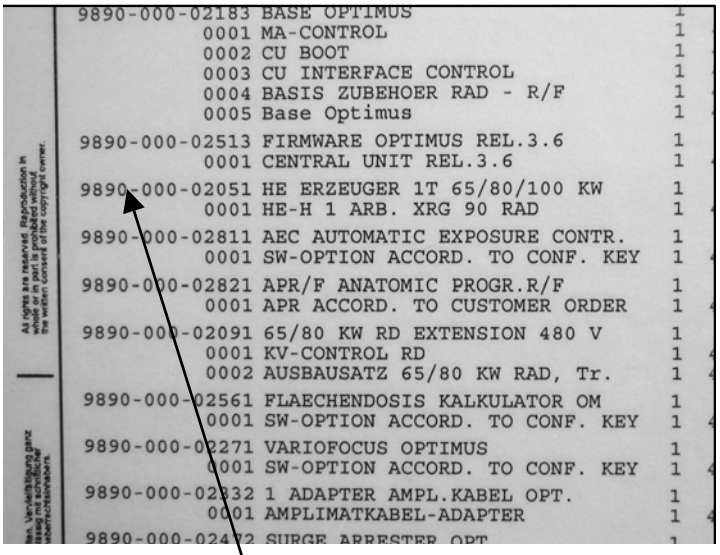
- Turn OFF generator and ENF1.
- Remove PCB EZ 130 (4512 108 0910x).

2.3. CHECK OF THE GENERATOR TYPE

- Check on the mastercard, which type of OPTIMUS generator (RAD, R/F or C) is present on site:

OPTIMUS "**RAD generators**" contain **RAD HV tanks 9890 000 020xx**.

OPTIMUS "**R/F or C generators**" contain **R/F HV tanks 9890 000 027xx**.


9890-000-02183 BASE OPTIMUS 1
0001 MA-CONTROL 1
0002 CU BOOT 1
0003 CU INTERFACE CONTROL 1
0004 BASIS ZUBEHOER RAD - R/F 1
0005 Base Optimus 1
9890-000-02513 FIRMWARE OPTIMUS REL.3.6 1
0001 CENTRAL UNIT REL.3.6 1
9890-000-02051 HE ERZEUGER 1T 65/80/100 KW 1
0001 HE-H 1 ARB. XRG 90 RAD 1
9890-000-02811 AEC AUTOMATIC EXPOSURE CONTR. 1
0001 SW-OPTION ACCORD. TO CONF. KEY 1
9890-000-02821 APR/F ANATOMIC PROGR.R/F 1
0001 APR ACCORD. TO CUSTOMER ORDER 1
9890-000-02091 65/80 KW RD EXTENSION 480 V 1
0001 KV-CONTROL RD 1
0002 AUSBAUSATZ 65/80 KW RAD, Tr. 1
9890-000-02561 FLAECHENDOSIS KALKULATOR OM 1
0001 SW-OPTION ACCORD. TO CONF. KEY 1
9890-000-02271 VARIOFOCUS OPTIMUS 1
0001 SW-OPTION ACCORD. TO CONF. KEY 1
9890-000-02832 1 ADAPTER AMPL.KABEL OPT. 1
0001 AMPLIMATKABEL-ADAPTER 1

High-voltage tank 9890 000 0xxxx

- With OPTIMUS RAD generators refer to 2.4. (page 7).
- With OPTIMUS R/F or OPTIMUS C generators refer to 2.5. (page 13).

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2.4. INSTALLATION IN OPTIMUS RAD GENERATORS

2.4.1. Installation of the RAD software

- Install the KV-Control RAD software 4512 113 20141 on the new PCB EZ130 (4512 178 00281) in socket D800.
- Install the new EZ130 (4512 178 00281) in the generator.

2.4.2. Adjustment of the factor for duty cycle

2.4.2.1. General information

The actual value of the set kV must be attained at least after 2ms. During the kV rise phase there must be neither kV break–in nor a kV overshoot.

The factor duty cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

- kV rise phase
- kV behavior during the exposure in falling load technique.

The factor duty cycle is stored in the memory of PCB CU EZ139.

Refer to figure 1:

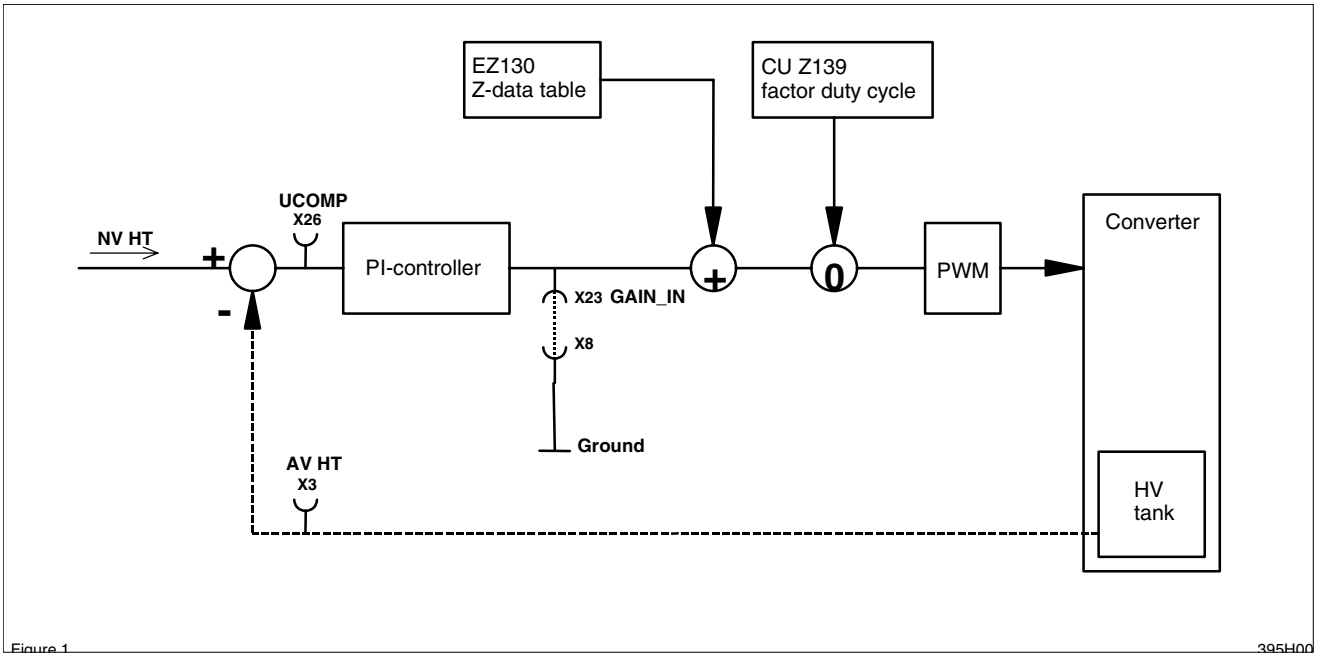

Figure 1 395H00

During alignment this factor duty cycle must be entered via AGenT. The influence of this factor as a correction value for the Z–data table is monitored as the U_{COMP} signal, since the PI–controller is deactivated by the grounded *GAIN_IN* signal.

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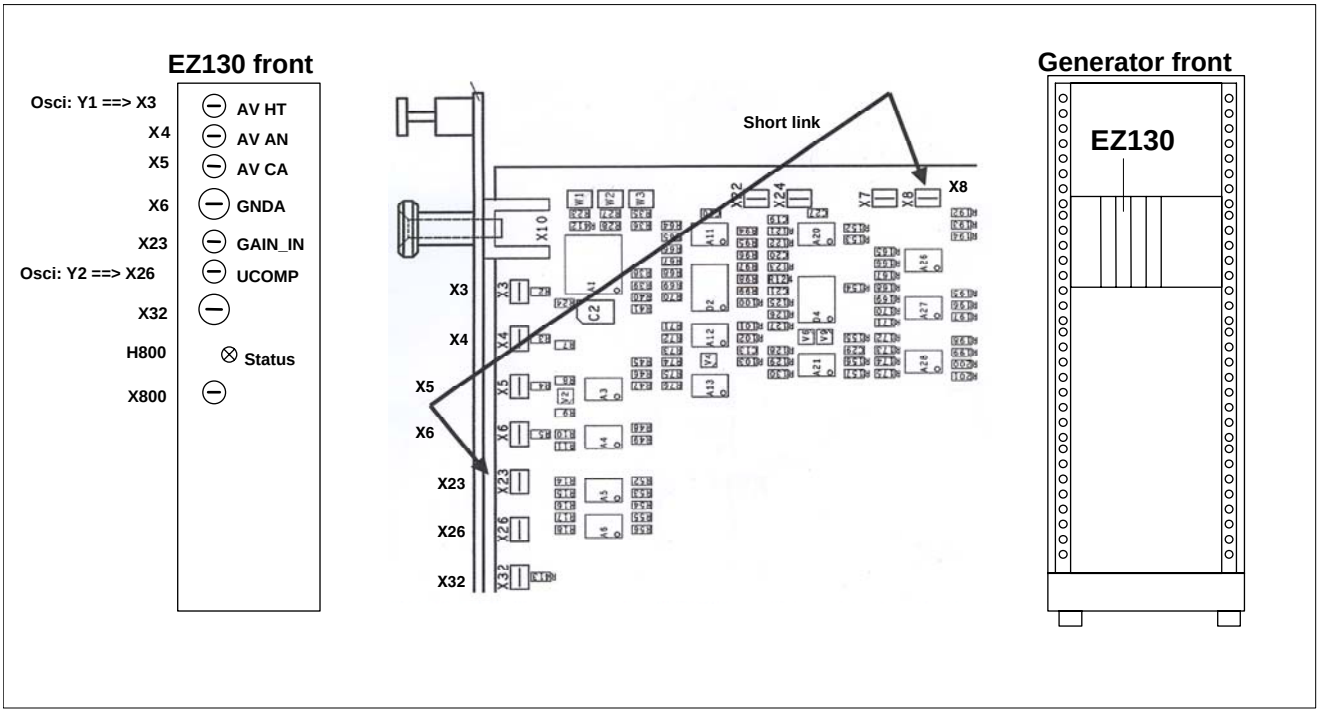
2.4.2.2. Connecting and setting the scope

For connections see figure 2:



Channel 1 = EZ130 X3 ---> *AV HT* ---> 20kV/V ---> 1V/div --> Zero–line at bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ---> U_{COMP} ---> 1V/div ---> Zero–line 2 div from bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Trigger = external (preferred) ---> *CTRL_X_C/* ---> backpanel EZX74 / negative slope
or = internal channel 1 ---> *AV HT* ---> EZ130 X3 / positive slope at +3V
Probe GND = one of the drilling holes at the front cabinet chassis

Time base = 5 or 10ms/div ---> trigger delay -1div

NOTE

A digital scope should not have any other ground connection than the ground of the three probes at the drilling holes at the front generator chassis.
A mains–driven scope must be isolated from earth potential, otherwise it might display artefacts.

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2.4.2.3. Deactivating the kV controller

- Connect EZ130 X23 GAIN_IN and X8 on board with a short link (use a short wire).

CAUTION

This alignment requires exposures with high kV.
Be sure the tube has been warmed up before.

2.4.2.4. Setting of exposure data

- Switch ENF1 and the generator ON.

a) Set 141kV in case
- of 65/80kW generators
- the tube limit (of at least one tube) is 150kV, perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case
- of 65/80kW generators if the programmed application limit of the tube limit is 125kV

NOTE

Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in chapter 3. (see page 19)
Disconnect the short link between X23 and X8.
Start over this adjustment from chapter 2.4.2.3. onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:
  - **a) 141kV:** 200mA (65/80kW)
  - **b) 125kV:** 200mA (65/80kW)

- Set the exposure time: 40ms

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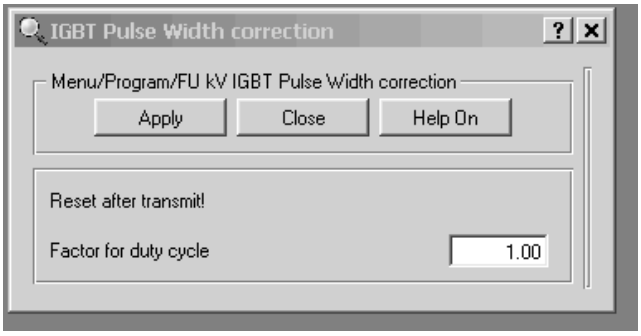
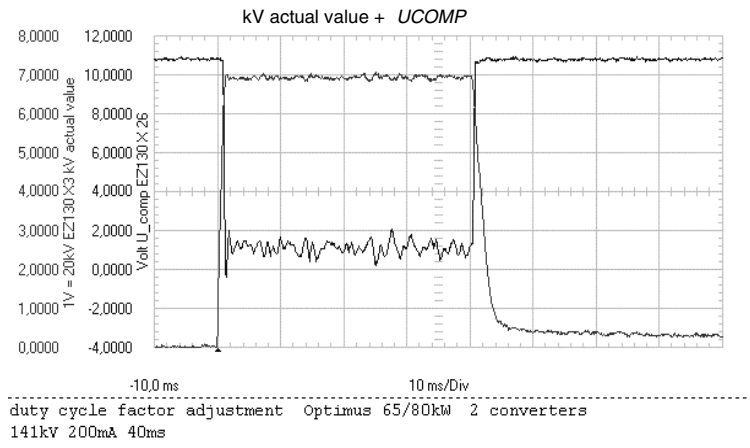
2.4.2.5. Adjustment of the factor for duty cycle

- Adjust the factor duty cycle via service software AGenT by measuring U_{COMP} with the scope.
- Connect the service PC and start AgenT. Select menu:
  Program / FU KV IGBT Pulse Width correction
- Set the starting value factor duty cycle to **1.00**:

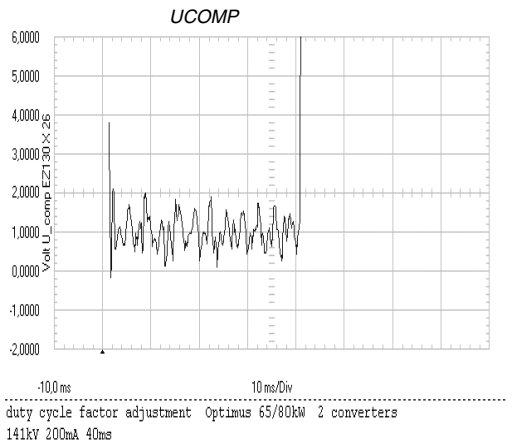


- If the U_{COMP} value does not match the requirements type in another factor duty cycle value.
  Transmit the factor by clicking on “Apply” with the left mouse button and push the active RGDV button to get the new value validated.
- Switch an exposure.
  The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:



Oscillogram of a perfect alignment for 141kV



UCOMP for 141kV

Figure 4 401H00

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a) 141kV setting

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the factor duty cycle till U_{COMP} meets the required reference of +1V.

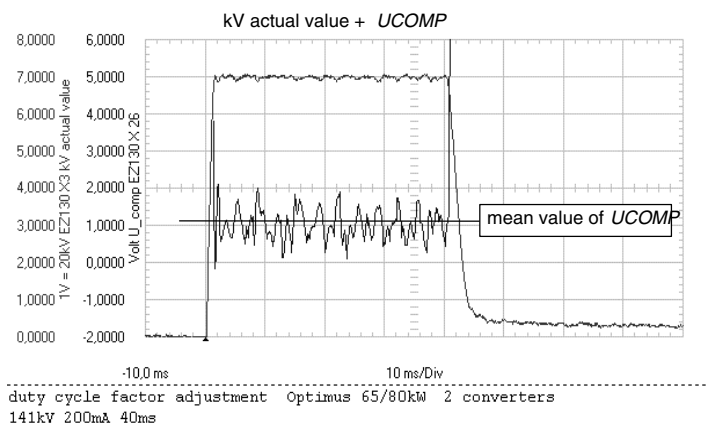
kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor duty cycle	Date
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor duty cycle, settings 141kV (150kV limit)

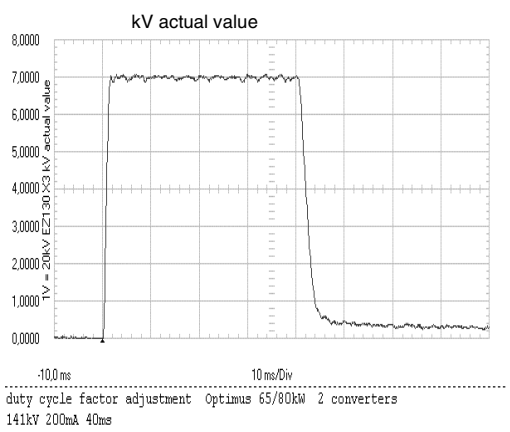
Example how to correct the factor duty cycle:

- If the mean value of U_{COMP} is: > +1.5V **increase** the factor duty cycle in steps of 0.01
  < +0.5V **decrease** the factor duty cycle in steps of 0.01

- Check also the kV peak value *AV HT* (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5)
- Remove the short link EZ130 X23 *GAIN_IN*.
- Record the results in table 1.


kV actual value + UCOMP
mean value of UCOMP
1V = 20kV EZ130 X3 kV actual value
Volt U_comp EZ130 X 26
-10,0 ms
10 ms/Div
duty cycle factor adjustment Optimus 65/80kW 2 converters
141kV 200mA 40ms

Optimus 80kW with 141kV, *UCOMP* = +1V


kV actual value
1V = 20kV EZ130 X3 kV actual value
-10,0 ms
10 ms/Div
duty cycle factor adjustment Optimus 65/80kW 2 converters
141kV 200mA 40ms

AV HT with overshoot

Figure 5 402H00

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b) 125kV setting

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the factor duty cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor duty cycle:	Date
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor duty cycle, 125kV limit

Example how to correct the factor duty cycle:

- If the mean value of U_{COMP} is: > +0.5V **increase** the factor duty cycle in steps of 0.01
- < -0.5V **decrease** the factor duty cycle in steps of 0.01

- Check also the kV peak value *AV HT* (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 *GAIN_IN*.
- Record the results in table 2.
- Turn OFF generator and ENF1.

2.4.3. Disposal

- Dispose:
  1. PCB EZ130 (4512 109 09101x)
  2. Old KV-Control-RAD software (4512 113 201xx)
  3. New KV-Control R/F software (4512 113 26221) not used

  according to local regulations.

2.4.4. Final test

- Switch ENF1 ON.
- Switch the generator ON.
- Test all applicable functions.

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2.5. INSTALLATION IN OPTIMUS R/F OR OPTIMUS C GENERATORS

2.5.1. Installation of the R/F software

- Install the KV-Control R/F software 4512 113 26221 on the new PCB EZ130 (4512 178 00281) in socket D800.
- Install the new PCB EZ130 (4512 178 00281) in the generator.

2.5.2. Adjustment of the factor for duty cycle

2.5.2.1. General information

The actual value of the set kV must be attained at least after 2ms. During the kV rise phase there must be neither kV break–in nor a kV overshoot.

The factor duty cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

- kV rise phase
- kV behavior during the exposure in falling load technique.

The factor duty cycle is stored in the memory of PCB CU EZ139.

Refer to figure 1:

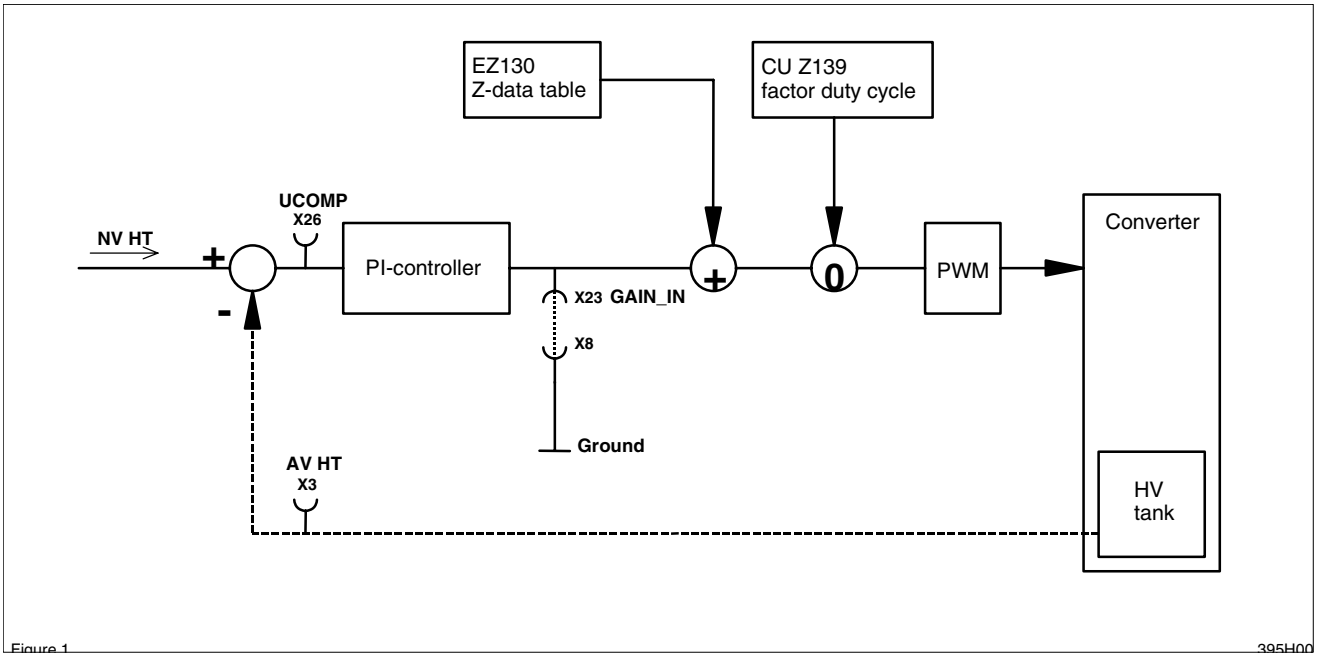

Figure 1 395H00

During alignment this factor duty cycle must be entered via AGenT. The influence of this factor as a correction value for the Z–data table is monitored as the U_{COMP} signal, since the PI–controller is deactivated by the grounded *GAIN_IN* signal.

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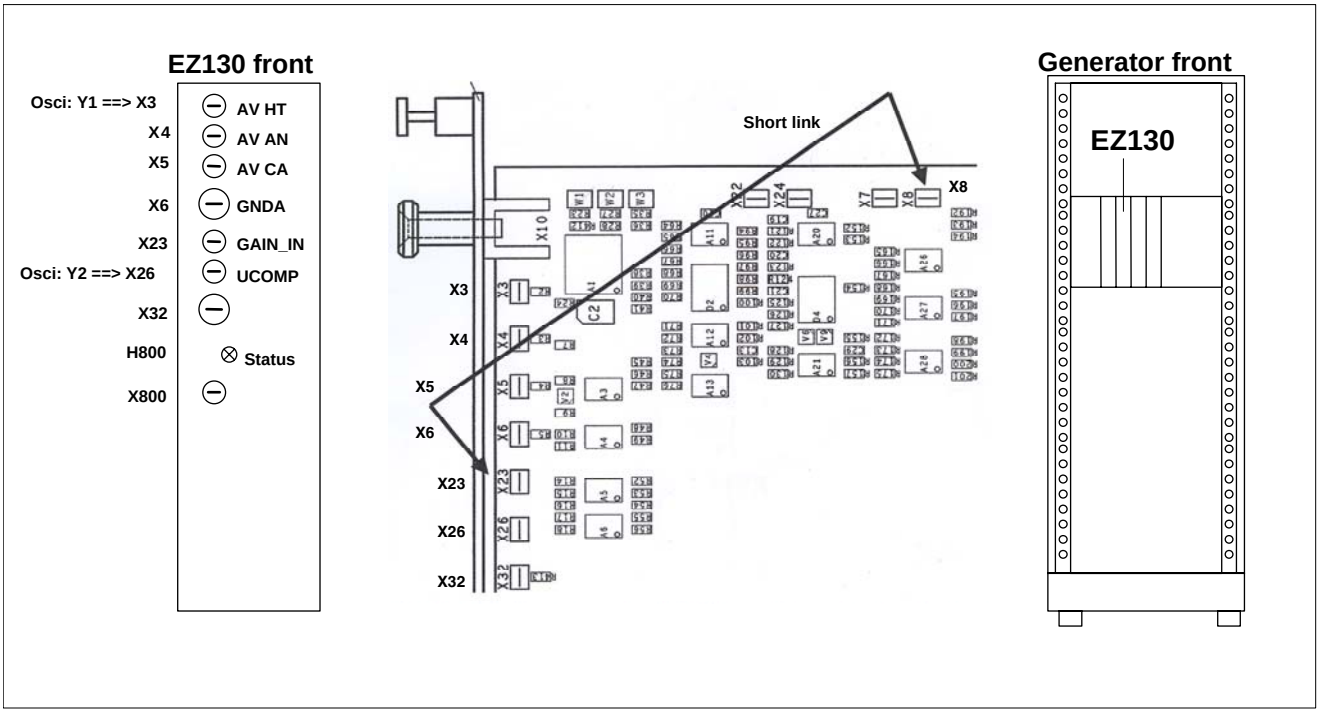
2.5.2.2. Connecting and setting the scope

For connections see figure 2:



Channel 1 = EZ130 X3 ---> *AV HT* ---> 20kV/V ---> 1V/div --> Zero–line at bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ---> U_{COMP} ---> 1V/div ---> Zero–line 2 div from bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Trigger = external (preferred) ---> *CTRL_X_C/* ---> backpanel EZX74 / negative slope
or = internal channel 1 ---> *AV HT* ---> EZ130 X3 / positive slope at +3V
Probe GND = one of the drilling holes at the front cabinet chassis

Time base = 5 or 10ms/div ---> trigger delay -1div

NOTE

A digital scope should not have any other ground connection than the ground of the three probes at the drilling holes at the front generator chassis.
A mains–driven scope must be isolated from earth potential, otherwise it might display artefacts.

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2.5.2.3. Deactivating the kV controller

- Connect EZ130 X23 GAIN_IN and X8 on board with a short link (use a short wire).

CAUTION

This alignment requires exposures with high kV.
Be sure the tube has been warmed up before.

2.5.2.4. Setting of exposure data

- Switch ENF1 and the generator ON.

a) Set 141kV in case
- of 65/80kW generators
- the tube limit (of at least one tube) is 150kV, perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case
- of 65/80kW generators if the programmed application limit of the tube limit is 125kV.

NOTE

Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in chapter 3. (see page 19).
Disconnect the short link between X23 and X8.
Start over this adjustment from chapter 2.5.2.3. onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:
  - **a) 141kV:** 200mA at kV_4 (65/80kW)
  - **b) 125kV:** 200mA at kV_4 (65/80kW)
- Set the exposure time: 40ms

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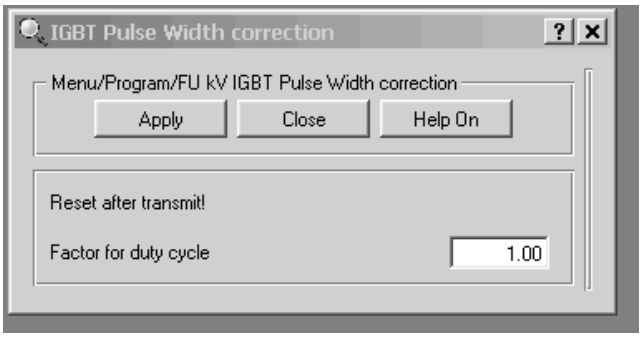
2.5.2.5. Adjustment of the factor for duty cycle

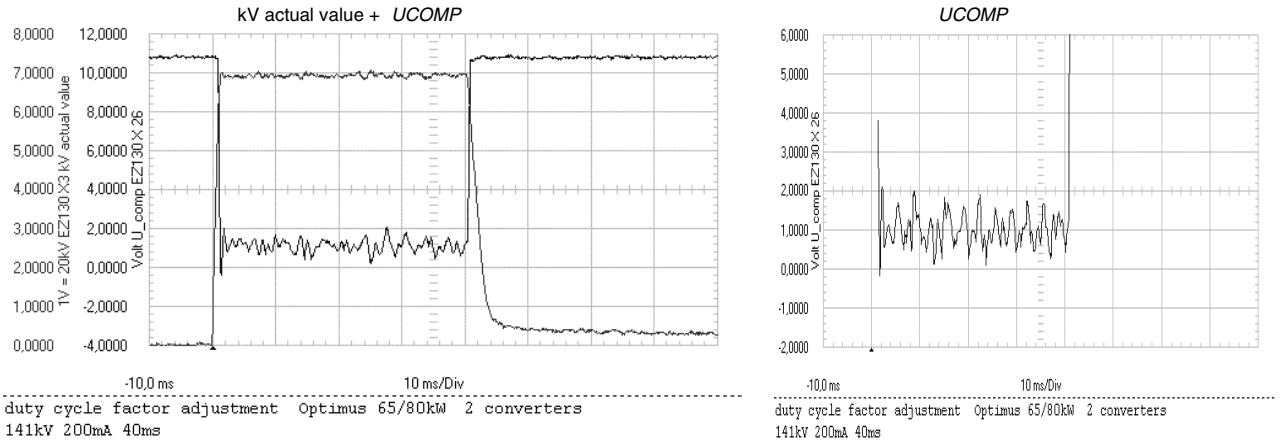
- Adjust the factor duty cycle via service software AGenT by measuring U_{COMP} with the scope.
- Connect the service PC and start AgenT:
  Select menu:
  Program / FU KV IGBT Pulse Width correction
- Set the starting value factor duty cycle to **1.00**:



- If the U_{COMP} value does not match the requirements type in another factor duty cycle value.
  Transmit the factor by clicking on “Apply” with the left mouse button and push the active RGDV button to get the new value validated.
- Switch an exposure.

  The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:



Oscillogram of a perfect alignment for 141kV

UCOMP for 141kV

Figure 4 401H00

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a) 141kV setting

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the factor duty cycle till U_{COMP} meets the required reference of +1V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor duty cycle	Date
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor duty cycle, settings 141kV (150kV limit)

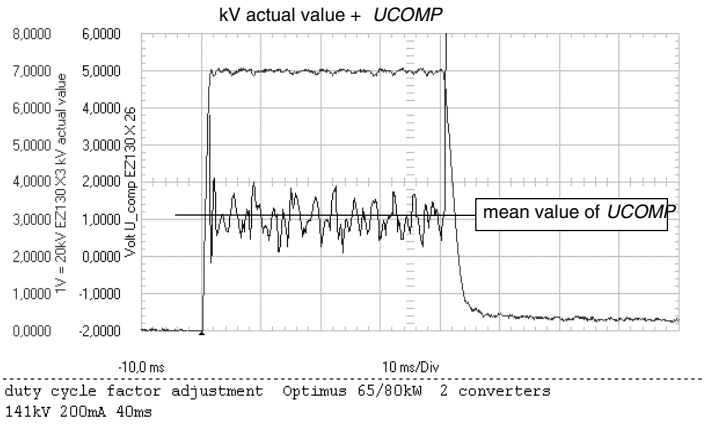
Example how to correct the factor duty cycle:

- If the mean value of U_{COMP} is: > +1.5V **increase** the factor duty cycle in steps of 0.01
- < +0.5V **decrease** the factor duty cycle in steps of 0.01

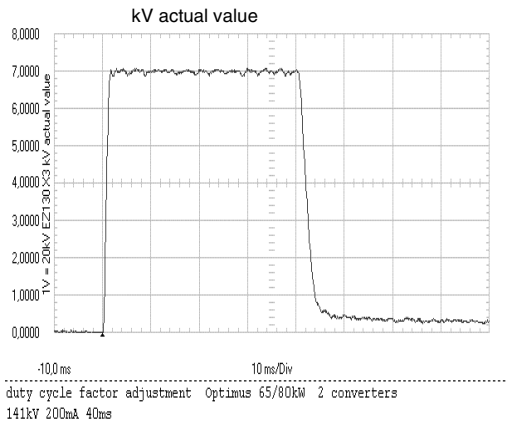
- Check also the kV peak value *AV HT* (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5).

- Remove short link EZ130 X23 *GAIN_IN*.

- Record the results in table 1.



Optimus 80kW with 141kV, *UCOMP* = +1V



AV HT with overshoot

Figure 5 402H00

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b) 125kV setting

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the factor duty cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor Duty Cycle:	Date:
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor duty cycle, 125kV limit

Example how to correct the factor duty cycle:

- If the mean value of U_{COMP} is: > +0.5V **increase** the factor duty cycle in steps of 0.01.
- < -0.5V **decrease** the factor duty cycle in steps of 0.01.

- Check also the kV peak value *AV HT* (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 *GAIN_IN*.
- Record the results in table 2.
- Turn OFF the generator and ENF1.

2.5.3. Disposal

- Dispose:

  1. PCB EZ130 4512 108 0910x
  2. Old KV-Control software
  3. New KV-Control RAD software (4512 113 20141) not used

  according to local regulations.

2.5.4. Final test

- Switch ENF1 ON.
- Switch the generator ON.
- Test all applicable functions.

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3. TUBE CONDITIONING

3.1. GENERAL

WARNING

Radiation is released during the conditioning procedure!

The generator must be in the READY state, i.e. the green ring at the desk must be illuminated.

3.2. PRECONDITIONS / PROGRAM SETTINGS

- Switch OFF the generator.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with bucky unit.

- Disconnect the following plugs.

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BuckyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with bucky unit	X	X	X

- Switch ON the generator.

NOTE

The programming procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched on.

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- Perform the following program settings temporarily for each tube connected to one of the assigned RGDVs = Free cassette
  Select menu AGenT:
  Program / RGDV set A + B / RGDV 1 ... 8 / Data Set A

Program setting	Temporarily	Original Tube
Enable handswitch	YES	
Syncmaster present	NO	
Exposure switch type	Double Step	
Exposure series / Tomo	YES	
Mounted radiographic	NONE	

- Reset the generator.
- Select appropriately programmed RGDV = “Free cassette” for the tube to be conditioned.

3.3. PROCEDURE

- Select **large** focus only.

NOTE

The generator must be in the READY state.

- Run reconditioning procedure for an adapted tube. Refer to the following table, left column “Tube adapted”.

or

- Run conditioning procedure for a new or non–adapted tube. Refer to the following table right column “Tube not adapted”.
- It is recommended that the high voltage be monitored during conditioning.
  Connect the scope:
  Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
  Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
  Time base: 2ms/div
- In case of problems like tube arcing see the following flowchart EXPOSURE SEQUENCE as an example.
  The flowchart applies to the applicable kV range only, e. g.:
  109kV is the max. kV value for normal application, set the next higher kV step = 117kV.

NOTE

Refer to flowchart EXPOSURE SEQUENCE.
If the tube arcs at a certain kV value, switch another three exposures with same parameters and 10s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the following table.
If the last exposure still arcs go one kV step back and follow the normal procedure. If this routine has been performed three times without improvement: ***==> Replace the tube!***

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Exposure parameters for conditioning

Tube adapted			# Exposures	Tube not adapted	
kV	mA	ms		kV	mAs
80	10	50	< 1 >	80	0.5
80	10	500	< 1 >	80	5
80	200	250	< 1 >	80	50
10 seconds pause				10 seconds pause	
80	max. mA	100	< 1 >	80	100
1 minute pause				1 minute pause	
90	10	50	< 1 >	90	0.5
90	10	500	< 1 >	90	5
90	200	250	< 1 >	90	50
10 seconds pause				10 seconds pause	
90	max. mA	100	< 1 >	90	100
1 minute pause				1 minute pause	
100	10	50	< 1 >	100	0.5
100	10	500	< 1 >	100	5
100	200	250	< 1 >	100	50
10 seconds pause				10 seconds pause	
100	max. mA	100	< 1 >	100	100
1 minute pause				1 minute pause	
110	10	50	< 1 >	110	0.5
110	10	500	< 1 >	110	5
110	200	250	< 1 >	110	50
10 seconds pause				10 seconds pause	
110	max. mA	100	< 1 >	110	100
1 minute pause				1 minute pause	
120	10	50	< 1 >	120	0.5
120	10	500	< 1 >	120	5
120	200	250	< 1 >	120	50
10 seconds pause				10 seconds pause	
120	max. mA	100	< 1 >	120	100
1 minute pause				1 minute pause	
130	10	50	< 1 >	130	0.5
130	10	500	< 1 >	130	5
130	200	250	< 1 >	130	50
10 seconds pause				10 seconds pause	
130	max. mA	100	< 1 >	130	100
1 minute pause				1 minute pause	

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Exposure parameters for conditioning

Tube adapted			# Exposures	Tube not adapted	
kV	mA	ms		kV	mAs
140	10	50	< 1 >	140	0.5
140	10	500	< 1 >	140	5
140	200	250	< 1 >	140	50
10 seconds pause				10 seconds pause	
140	max. mA	100	< 1 >	140	100
1 minute pause				1 minute pause	
145	10	50	< 1 >	145	0.5
145	10	500	< 1 >	145	5
145	200	250	< 1 >	145	50
10 seconds pause				10 seconds pause	
145	max. mA	100	< 1 >	145	100
1 minute pause				1 minute pause	
148	10	50	< 1 >	148	0.5
148	10	500	< 1 >	148	5
148	200	250	< 1 >	148	50
10 seconds pause				10 seconds pause	
148	max. mA	100	< 1 >	148	100
1 minute pause				1 minute pause	
150	10	50	< 1 >	150	0.5
150	10	500	< 1 >	150	5
150	200	250	< 1 >	150	50
10 seconds pause				10 seconds pause	
150	max. mA	100	< 1 >	150	100
1 minute pause				1 minute pause	

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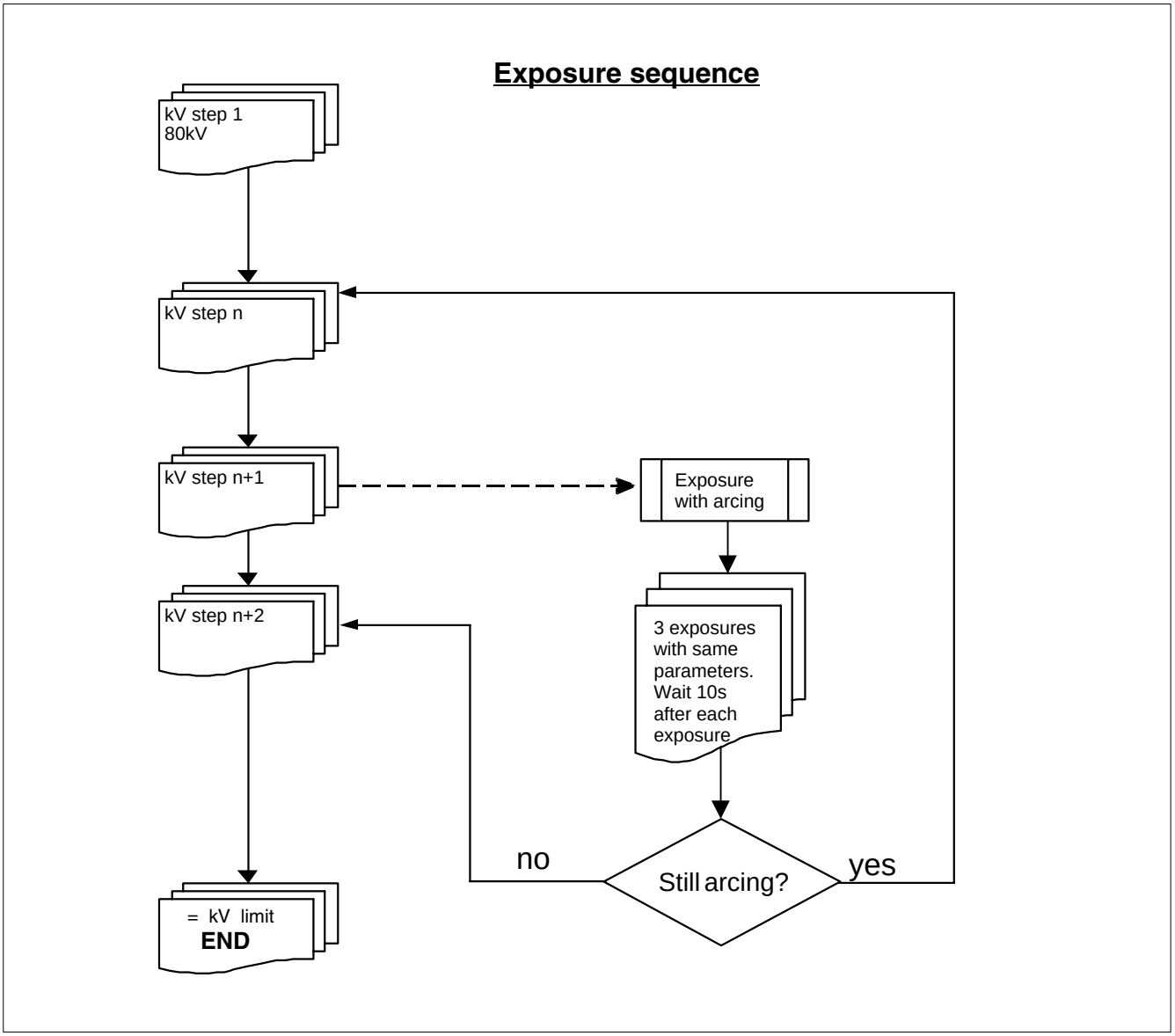

NOTE

If a tube arcs at any kV value which is not required for application, program the max. application kV value with AGenT:
Program / Tubes / Tube Limits / Max. Tube Voltage Limit [kV] / [117]

As the max. kV value has decreased now, the field ADAPTED TO [kV] displays the max. value after adaptation as well.

- Set the RGDV programming to the original status if no adaptation procedure has to be executed.
- Reset the generator.

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